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TOMORROW'S RATIONS FOR DAIRY COWS

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From the title of this discussion it would appear that we are going to look into a crystal ball to see what sort of rations are to be fed to dairy cows in the future. I wish that I could forecast the future that easily, but since I do not possess such powers I find it necessary to attempt to use some sort of intelligent judgment, taking into consideration what has transpired in the past and noting also the present developments in the field.

My judgment may point in a certain direction, but whether I am able to puncture the advancing curtain of the future can be judged only by the future. I might be safe in predicting for a few days or weeks, but science and economic changes often take turns in directions least expected.

Concentrate rations fed to milk cows[1]

Milk cows on United States farms in 1954 were fed an estimated total of 18,721,000 tons of grain and concentrate feeds - the second largest quantity fed in almost a quarter century of records. Of this total, 16,986,000 tons, or 91%, were fed on farms where milk or cream was sold, and 1,735,000 tons, or 9%, on farms where milk was produced for home use only. The total volume of grain and concentrates fed on farms in 1954 was up 1% from 1953, with heavier use of grain and concentrates in all regions except the West North Central. Increases ranged from a fractional gain in the East North Central to 4% in the South Central region. Wisconsin again led in total quantity of grains and concentrates fed to milk cows with 2,082,000 tons; followed by New York with 1,380,000 tons; Minnesota, 1,103,000 tons; and Pennsylvania, 1,064,000 tons. For data on grain and concentrates fed by regions, see table 1.

Grain and concentrates fed per milk cow on farms averaged 1,659 pounds in 1954, only slightly below last year's record of 1,676 pounds. Regional feeding rates were highest in the North Atlantic area, averaging 2,038 pounds per cow; followed by the East North Central, 1,845 pounds; South Atlantic, 1,647 pounds; West, 1,592 pounds; West North Central, 1,554 pounds; and lowest in the South Central region with 1,310 pounds.

1/ This section, taken verbatim from "Rations fed to milk cows, 1954" A.M.S., U.S.D.A.

Importance of feed industry to dairy production

Before entering into this discussion of the future some comment on the importance of the feed industry in the production of milk. The feed industry performs the important function of mixing and transporting feeds from the grain producing areas to grain deficient areas. This function has increased tremendously during the past 20 years until about 30% of the concentrates fed to dairy cattle in the United States are commercial mixed feeds. The increase is shown in figure 1. This means a total of about 5-1/4 million tons of commercial mixed feeds are fed to dairy cattle each year, worth about 0.4 of a billion dollars. As your cattle numbers increase and grassland farming increases, the feed industry will undoubtedly play a greater part in the production of milk. Generally speaking, the feed industry gives the dairy farmer good service.

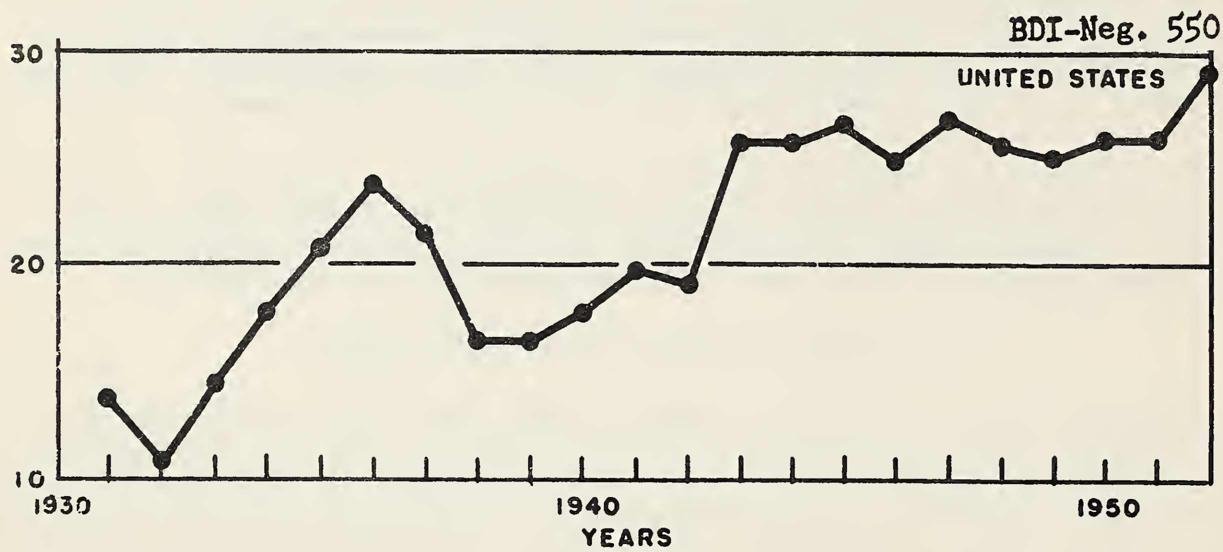


Figure 1.-Commercial mixed feeds fed to dairy cows, shown as a percentage of all concentrates fed to dairy cows, in the United States.

Importance of grassland farming

In order to understand what is to happen to tomorrow's rations for dairy cows, we must also understand a change that is taking place in farming in this country. I refer to the increase in grassland agriculture. This change means an increase in the utilization of pastures and preserved forages for dairy cattle. Since the kind and type of the concentrate ration fed is dependent upon the forage, let us digress and examine the extent, nature, and meaning of grassland farming in the production of milk.

Table 1.-Individual feeds as percentage of the total concentrate ration fed to milk cows in herds kept by dairy reporters, by Regions, 1954 1/

Regions	Corn	Small grains			Oil seeds and oil-seed meals				Other millfeeds		Commercial mixed feed	Misc. Other
		Oats	Barley	Wheat	Cottonseed meal	Cotton-seed	Linseed meal	Soybeans or S. B. meal	Gluten feed or meal	Wheat bran, shorts		
					Percent of total							
N. Atl.	13.4	13.7	2.8	1.2	.2	-	.6	.8	1.0	1.7	59.9	4.7
E. N. Cent.	46.6	33.8	1.2	.5	.2	-	2.3	1.6	.3	3.0	7.5	3.0
W. N. Cent.	43.1	31.8	3.1	.4	.9	.2	.6	1.3	.1	3.2	11.7	3.6
S. Atl.	21.9	11.5	5.3	1.0	3.8	.5	.5	.7	.2	2.4	41.2	11.0
S. Cent.	30.3	11.5	1.4	.9	6.5	1.4	.2	1.1	.4	3.1	37.4	5.8
West	2.5	10.6	12.9	1.9	1.6	.3	.4	.3	.2	4.5	54.2	10.6
U. S.	31.7	23.1	3.3	.8	1.6	.3	1.0	1.1	.4	2.9	28.7	5.1

1/ Adapted from "Rations fed to Milk Cows. 1954", Agricultural Marketing Service, U.S.D.A. Based on reports of rations fed on May 1 and November 1.

The former Bureau of Agricultural Economics of the United States Department of Agriculture conducted an excellent study2/ of the changes taking place in dairy farming in the Northeast. Work of the kind reported in the study is now performed by the Production Economics Research Branch, Agricultural Research Service.

The survey shows that there has been an increase not only in the acres of hay equivalent per farm but also in the hay equivalent produced per acre. Hay equivalent refers to forage produced as hay and silage. The data also show that the production of hay equivalent per farm has increased about 50% from 1930 to 1950. These relationships are shown in figure 2.

Of the 71 acres of crops harvested per farm in 1950, hay accounts for 64%, small grains 23%, and corn 12%. Roughly 7% of the acreage of hay is alfalfa; about 50% contains significant quantities of other legumes, of which red alsike clovers are the most important.

There has also been a general shift in many areas from corn silage to grass silage, with a tremendous increase in the use of grass silage. These shifts are shown in table 2. In some areas sorghum silage has replaced corn silage. The dairy business calls for a grassland program to produce cheap feed. Good pasture and forage are the backbone of the dairy industry.

Table 2.-Changes in kinds of silage fed to milk cows in herds kept by dairy reporters, during the winter feeding period.

	1946-50	1951-52	1953
	Percent	Percent	Percent
United States:			
Corn silage	85	74	70
Grass silage	4	14	21
North Atlantic States:			
Corn silage	86	73	67
Grass silage	10	22	31

2/ Fowler, H. C. Changes in dairy farming in the Northeast, 1930-51. U. S. Dept. Agr., Agr. Inform. Bul. 86, 55 pp. 1952.

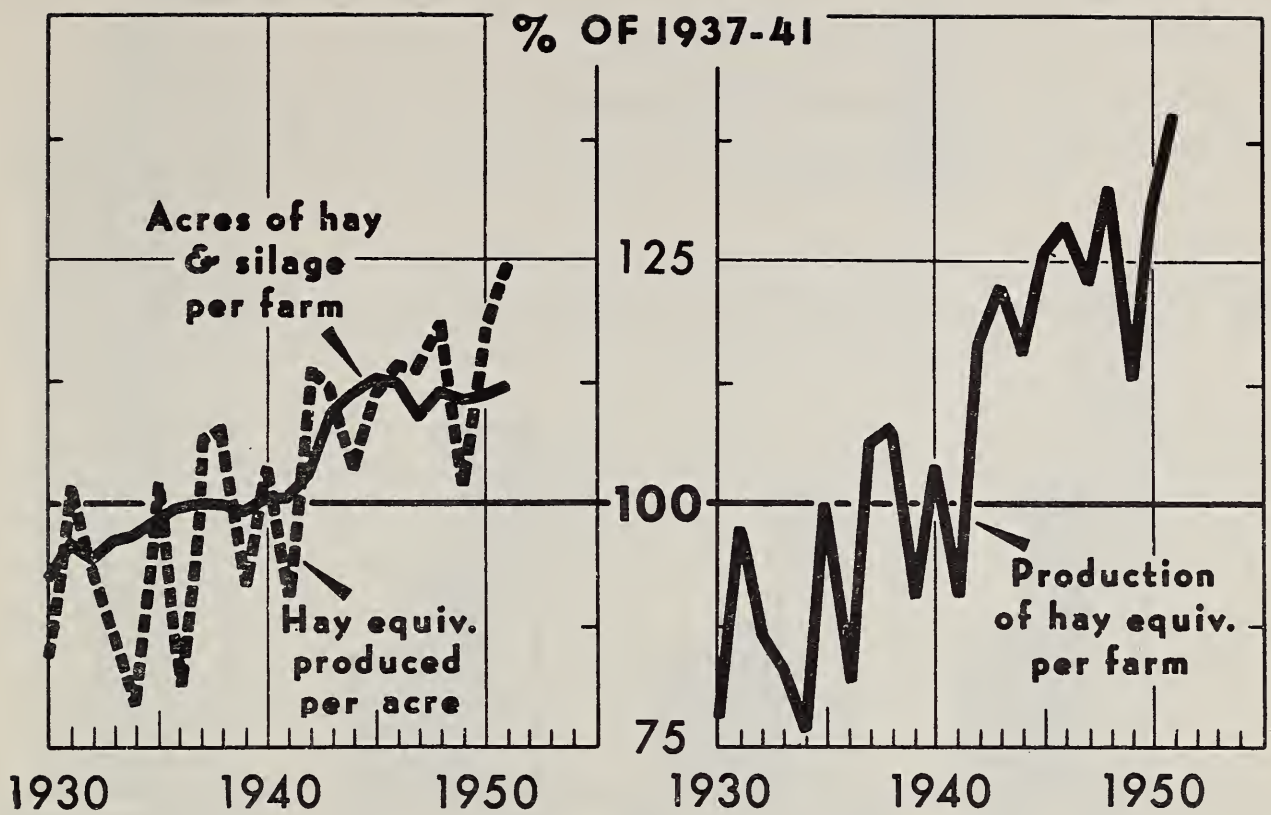


Figure 2.-Changes in the production of hay equivalent per acre and per farm, in the Central Northeast Area, 1930-50.

The making of hay crops into grass silage is a more efficient and more certain method of conserving the nutrients in hay crops. The making of hay crops into field-cured hay means gambling with the weather for 36 to 72 hours or more, whereas making the crop into silage means gambling for only a few hours. The results of recent hay harvesting experiments conducted by the Dairy Husbandry Research Branch are shown in figure 3.

The shifts brought about by grassland agriculture mean that more and better forages are being fed to our milking herds. This means that more milk in the future will be produced from grassland crops.

The shift to grassland crops does not necessarily mean that the dairy farmer is going to purchase a lot less feed per cow but, depending on price relationships, it probably means that he is going to produce more milk per cow because of an increased energy intake. This means more profit for the farmer. This shift is necessary in order for him to remain in competition with dairymen from other states.

This shift also means that, because of legumes being used in the hay crops, more protein is being consumed from forage.

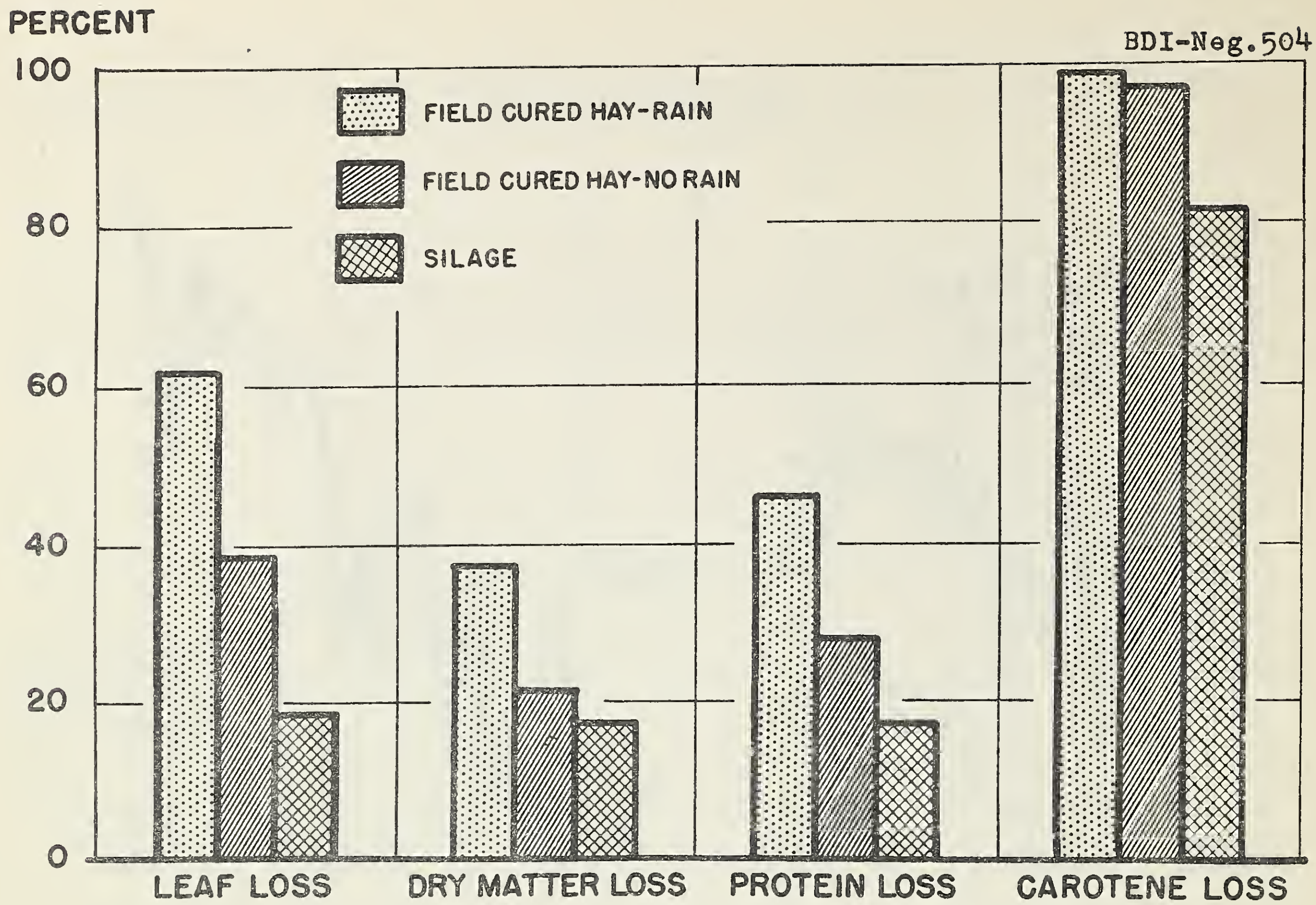


Figure 3.-Losses from forage harvested as hay and as silage at Beltsville, Md.

Protein levels in concentrate rations

The statistics indicate that dairymen are purchasing considerable amounts of protein concentrates or supplements and mixing them with the home grown grains which is a desirable practice. It would also appear that dairymen are probably feeding ample protein on the average. Some may be overfeeding on protein.

In general, it is recommended that where the forage part of a ration consists of poor-quality grass hay, the grain mixture should contain about 20 to 24% of protein; where the forage is mixed hay, about 16 to 18%; and where the forage is good-quality legume hay, 12 to 14%.

Results of feeding different levels of protein

In order to study the protein needs of dairy cattle, an experiment was conducted at Beltsville with three grain mixtures. One contained 10 to 11% of total protein, one contained 14.5 to 15.5% of total protein, and one contained 18.5 to 19.5% of total protein. The three mixtures were essentially the same in fat, fiber, calcium, phosphorus, and total digestible nutrient content.

In order to keep the protein intake at a low level, the cows were fed No. 1 timothy hay at the rate of 10 to 12 pounds per 1,000 pounds of body weight and 3 to 4 pounds of No. 1 alfalfa per 1,000 pounds of body weight. Corn silage was fed at the rate of 15 pounds per 1,000 pounds of body weight. The cows were fed total digestible nutrients at the rate of 110% of their requirement. None of the cows were on pasture and most of the cows remained on the ration for three consecutive lactations.

The results, as shown in table 3, show that there were no marked differences in milk production among the three groups of cows. It seems, therefore, that the protein content of the grain mixture could be 3 or 4 percentage points lower than is now generally recommended.

It is wasteful of protein for a dairy farmer to feed a 20% protein ration to a herd receiving largely legume grass silage, since a 12% protein would be adequate. Under most conditions I see little need for feeding rations containing much more than 18% of protein to producing dairy herds. The deficiency, if one exists, is more likely to be energy rather than protein.

Table 3.-Effect of level of protein intake on milk and fat production (Cows milked twice a day for 305 days)

Lactation No. and level of protein intake	Cows	Average Production			Average Production (4% fat-corrected milk)	
		Milk	Butterfat			Mature-equivalent
	Number	Pounds	Percent	Pounds	Pounds	Pounds
1st lactation						
Low	5 1/	8,183.2	4.16	340.2	8,376.3	8,605.9
Medium	4 2/	7,493.8	4.46	334.7	8,018.2	8,079.5
High	4 3/	7,251.8	4.60	333.2	7,872.2	7,948.3
2nd lactation						
Low	5 1/	8,744.3	4.05	354.4	8,812.1	8,859.7
Medium	4 2/	8,205.8	4.35	357.1	8,637.9	8,734.4
High	4 2/	7,058.8	4.96	291.5	7,899.2	7,953.0

1/ 2 Holstein and 3 Jerseys 2/ 1 Holstein and 3 Jerseys
3/ 1 Holstein and 3 Jerseys (averages exclude 1 cow)

Feeding Urea

Since we have been discussing protein it would be well at this point to turn our thoughts to the possible use of urea in dairy rations.

Urea is not protein but can be utilized as a substitute for protein by ruminants, such as cattle, sheep and goats. Ruminants, which have four stomachs, are able to utilize the urea because the bacteria in the paunch are able to convert it to amino acids and protein. The protein is stored in the bacteria and becomes available to the host animal as the bacteria are digested during their passage from the paunch into the true stomach and intestines.

Most all the experimental data show quite definitely that urea is not effective when added to high-protein grain rations for milk production purposes. Thus, urea should not be added to grain rations already containing 14 to 18% of protein. It is most effective when added to grain rations containing 10% or less of protein, such as home-grown grains. It appears that when urea is added to a mixture containing 10 to 11% of protein, it may be utilized to the extent of 60 to 80%; but if it is added to a mixture already containing 16 to 18% of protein it will be utilized to the extent of 40% or less. Readily soluble and hydrolyzable protein in the ration decreased the utilization of urea in the ration because the bacteria prefer this form of nitrogen. A high level of starch favors the utilization of urea nitrogen and sugar and cellulose as carbohydrate sources are inferior to starch.

Urea is toxic when fed in too large quantities. Some results from England showed that when more than 3 ounces of urea was fed per day, there was a depressant effect on milk production. If this is true, and the amount of urea is 3% of the grain ration, then a cow should not receive more than 6 or 7 pounds of grain per day. This would preclude the use of such a grain mixture for high-producing cows.

Whether urea will be used in place of protein concentrates is largely a matter of economics and availability of grains, other protein concentrates and forages, taking into consideration the prices of protein and carbohydrate concentrates.

In the Eastern States where the differences in prices of protein and carbohydrate concentrates are not often greatly different, it would seem doubtful that urea would be used to any large extent except when the supplies of protein concentrates are limited. On the other hand, in the Midwest, where the carbohydrate concentrates are generally lower in price compared to protein concentrates, the use of urea would be more justified. If the cost of 1 pound of urea and 6 pounds of carbohydrate concentrates is less than the cost of 7 pounds of protein concentrates, it would be more economical to use urea.

It is possible that further research will bring forth information on how to use urea so that it will be utilized by the ruminant more efficiently. It is also possible that other nitrogen compounds that are less water soluble and thus permit the ammonia nitrogen to be released in the paunch over a longer period after consumption, would be more advantageous.

Urea can be used for wintering dry dairy cows and growing heifers. With dry cows and heifers it is possible to utilize some of the poorer quality forages along with urea and a source of readily available carbohydrate such as cereal grains and molasses. Of course, if good quality legume hay is made available to growing dairy heifers they will make normal gains without a grain supplement, according to recent work by the Dairy Husbandry Research Branch.

The ammoniated products

There has also been considerable interest in the use of ammoniated feed products such as molasses, beet pulp, and various carbohydrate by-products. Some very good work on the use of the ammoniated products has been conducted at the Pennsylvania State College. The results thus far indicate that these products are useful as sources of protein and energy for dairy cows. The extent to which this source of nitrogen can be used as a protein source in the ration, in comparison to urea, is not clear at this time. Also, the relative cost of this source of nitrogen in comparison to urea and protein concentrates is not clear at this time. However, under certain conditions, as pointed out in the discussion of urea, these products will probably assume a more important role in dairy cattle feeds.

Profitable level of feeding grain

The cost of feed in relation to the price of milk largely determines the profit made from a herd of cows. Usually the cheapest source of nutrients comes from the forage or pastures. Experiments by the Dairy Husbandry Research Branch have shown that when cows are fed an all-forage ration (without grain) they will produce about 70% as much milk as when they are fed grain with the forage. The forage, however, must be of excellent quality. Unless the price of milk is low in relation to the price of grain it will usually pay to feed some grain.

Cooperative work by the U. S. Department of Agriculture and various experiment stations some years ago showed the amount of milk that might be expected from different levels of grain feeding for cows with the ability to produce around 9,000 pounds of milk per year. Table 4 shows the smoothed data from these experiments. It will be noted that as grain consumption is increased hay consumption decreases and milk production increases. Using these data the value of milk above feed costs were calculated at the level at which grain can be fed for the greatest return above feed costs, as shown in table 5. Thus, it can be seen that the price of grain and hay affect the level at which grain can be fed for the greatest return.

A general idea of the level at which grain can be fed for greatest return can be obtained from figure 4. In order to clarify the use of the graph an example is given as follows. If the price of milk is $4.00 per 100 pounds the cost of grain $3.00 per 100 and the cost of hay $20.00 per ton at what rate can grain be fed for the greatest return. According to

Table 4.-Smoothed data from 6 feeding levels at 9 stations and 2 feeding levels at 2 stations prepared for the purpose of estimating the most profitable rate at which to feed grain

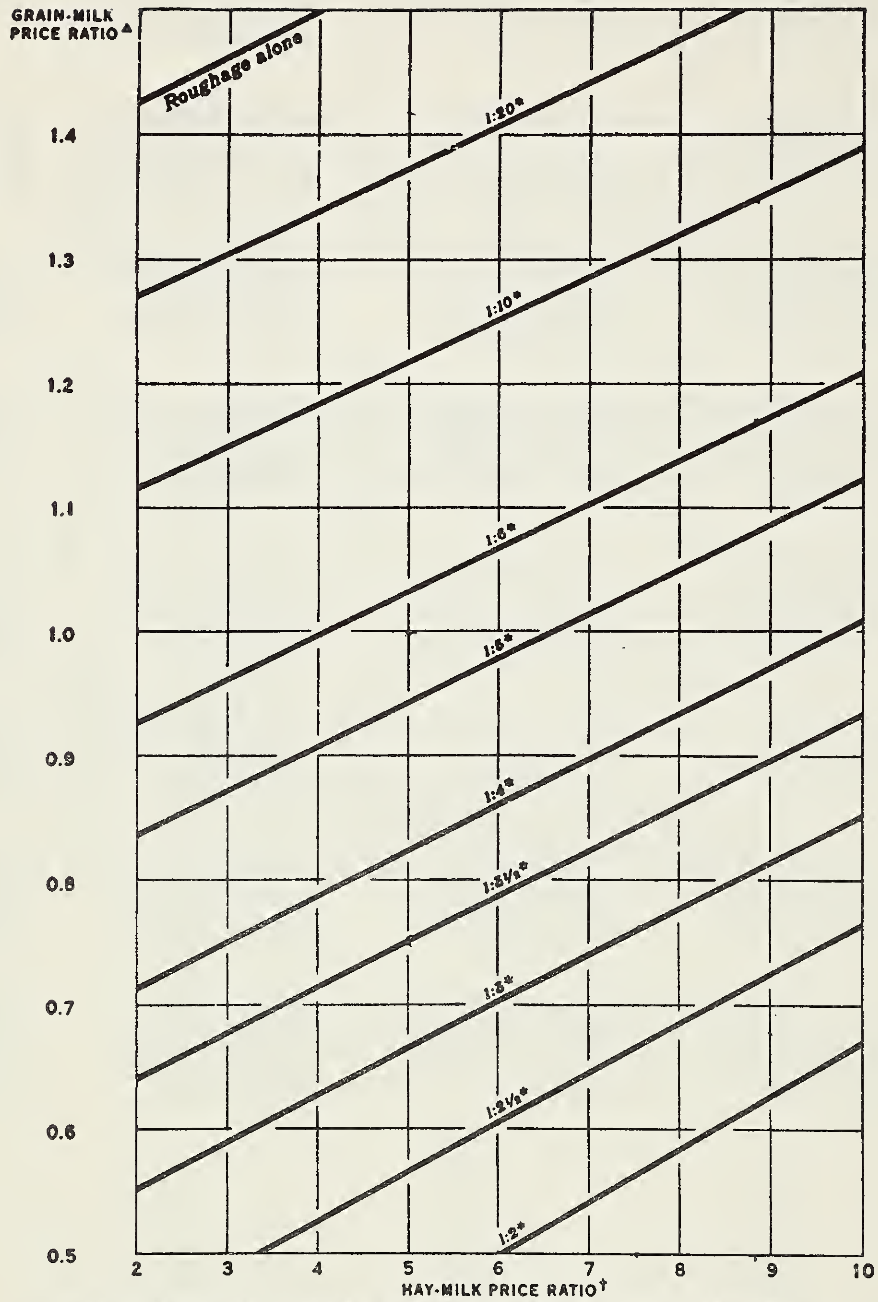
level of feeding from lowest to highest	live weight	roughage expressed as hay equivalent per 100 pounds live weight	total hay equivalent fed in a year	grain fed in a year	grain fed during lactation period	adjusted total digestible nutrients	estimated quantities of milk these feeds would produce	milk produced per pound of grain fed during lactation
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1	1,080	2.9	11,338	0	0	5,102	6,438	----
2	1,090	2.8	11,048	450	420	5,376	7,020	16.7
3	1,100	2.7	10,751	900	840	5,642	7,517	8.9
4	1,110	2.6	10,447	1,350	1,260	5,901	7,947	6.3
5	1,120	2.5	10,136	1,800	1,680	6,154	8,317	5.0
6	1,130	2.4	9,817	2,250	2,100	6,400	8,639	4.1
7	1,140	2.3	9,492	2,700	2,520	6,638	8,915	3.5
8	1,150	2.2	9,159	3,150	2,940	6,868	9,156	3.1
9	1,160	2.1	8,818	3,600	3,360	7,091	9,366	2.8
10	1,170	2.0	8,471	4,050	3,780	7,307	9,550	2.5
11	1,180	1.9	8,116	4,500	4,200	7,514	9,708	2.3
12	1,190	1.8	7,754	4,950	4,620	7,713	9,847	2.1
13	1,200	1.7	7,385	5,400	5,040	7,905	9,971	2.0

Table 27, Technical Bulletin 815, U.S.D.A.

Table 5.-Value of Milk above Feed Cost at Varying Grain to Milk Ratios

	Ratio of Grain to Milk								
	00	1:8.9	1:6.3	1:5.0	1:4.1	1:3.5	1:3.1	1:2.5	1:2.0
	Milk $4.00/100 Hay $30.00/ton Grain $60.00/ton								
Value of Milk	257.52	300.68	317.88	332.68	354.56	356.60	366.24	382.00	398.84
Cost of Hay	170.07	161.27	156.71	152.04	147.26	142.38	137.39	127.07	110.78
Cost of Grain	----	25.20	37.80	50.40	63.00	75.60	88.20	113.40	151.20
Total Feed Cost	170.07	186.47	194.51	202.44	210.26	217.98	225.59	240.47	261.98
Value of Milk above Feed Cost	87.45	114.21	123.37	130.24	135.30	138.62	140.65	141.53	136.86
Profit on Grain	00	26.76	35.92	42.79	47.85	51.17	53.20	54.08	49.41
	Milk $4.00/100 Hay $30.00/ton Grain $80.00/ton								
Value of Milk	257.52	300.68	317.88	332.68	354.56	356.60	366.24	382.00	398.84
Cost of Hay	170.07	161.27	156.71	152.04	147.26	142.38	137.39	127.07	110.78
Cost of Grain	----	33.60	50.40	67.20	84.00	100.80	117.60	151.20	201.60
Total Feed Cost		194.87	207.11	219.24	231.26	243.18	254.99	278.27	312.38
Value of Milk above Feed Cost	87.45	105.81	110.77	113.44	114.30	113.42	111.25	103.73	86.46
Profit on Grain	00	18.36	23.32	25.99	26.85	25.97	23.80	16.28	-0.99
	Milk $4.00/100 Hay $20.00/ton Grain $60.00/ton								
Value of Milk	257.52	300.68	317.88	332.68	354.56	356.60	366.24	382.00	398.84
Cost of Hay	113.38	107.51	104.47	101.36	98.17	94.92	91.59	84.71	73.85
Cost of Grain	----	25.20	37.80	50.40	63.00	75.60	88.20	113.40	151.20
Total Feed Cost	113.38	132.71	142.27	151.76	161.17	170.52	179.79	198.11	225.05
Value of Milk above Feed Cost	144.14	168.97	175.61	180.92	184.39	186.08	186.45	183.89	173.79
Profit on Grain	00	24.83	31.47	36.78	40.25	41.94	42.00	39.75	29.65
	Milk $4.00/100 Hay $20.00/ton Grain $80.00/ton								
Value of Milk	257.52	300.68	317.88	332.68	354.56	356.60	366.24	382.00	398.84
Cost of Hay	113.38	107.51	104.47	101.36	98.17	94.92	91.59	84.71	73.85
Cost of Grain	----	33.60	50.40	67.20	84.00	100.80	117.60	151.20	201.60
Total Feed Cost	113.38	141.11	154.87	168.56	182.17	195.72	209.19	235.91	275.45
Value of Milk above Feed Cost	144.14	159.57	163.01	164.12	163.39	160.88	157.05	147.09	123.39
Profit on Grain	00	15.43	18.87	19.98	19.25	16.74	12.91	2.95	-20.75

Calculated from Table 27 from Technical Bulletin 815, U.S.D.A.



*COWS FED 1 POUND OF GRAIN TO EVERY 2 POUNDS OF MILK DURING THE LACTATION PERIOD ARE SAID TO BE FED AT THE LEVEL OF 1:2; ETC.

▲PRICE OF 100 POUNDS OF GRAIN DIVIDED BY PRICE OF 100 POUNDS OF 4-PERCENT FAT-CORRECTED MILK.

†PRICE OF 1 TON OF HAY OR HAY EQUIVALENT DIVIDED BY PRICE OF 100 POUNDS OF 4-PERCENT FAT-CORRECTED MILK.

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Figure 4.—Chart Showing the Most Profitable Level of Grain Feeding, When Cows Have Free Access to Good Roughage.

directions in the graph the cost of 100 pounds of grain is divided by the price of 100 pounds of milk or \$3.00 ÷ 4.00 = 0.75. This point is then located on the vertical axis of the graph between 0.7 and 0.8. Then the cost of 1 ton of hay is divided by the price of 100 pounds of milk or \$20.00 ÷ \$4.00 = 5.0. This point is located on the horizontal axis of the graph at 5.0. By drawing lines across from the point 0.75 and up from 5.0 the intercept occurs at the line 1:3 1/2. This means that with the above prices concentrates can be fed at the rate of 1 pound of grain for each 3 1/2 pounds of milk produced.

In using such information some judgment is necessary. For instance, if the quality of forage is poor, then grain should be fed at a heavier rate. The graph is calculated for 4% milk so that a heavier rate would be required for the higher testing breeds.

Feeding thyroprotein to dairy cattle

Thyroprotein, a hormone product that will increase milk production when fed to dairy cows, has been available to the feed industry for some time. The hormone product is mixed with a concentrate mixture so that when 3 pounds of the mixture is fed per day per cow, the correct amount of hormone will be consumed.

An experiment was carried out by the Dairy Husbandry Research Branch in which thyroprotein was fed for approximately 300 days of each lactation for the length of time that the cow remained in the herd. Twenty cows were started in their first lactation and 3 completed their sixth lactation in the group that received thyroprotein. Control cows were maintained under identical conditions. No evidence of reproductive difficulties, early senescence, or increased rate of disposal or turnover was found in the cows that received thyroprotein.

Thyroprotein caused an immediate increase in the level of milk production, as shown in figure 5, and in butter fat test in practically all animals.

The feeding of extra nutrients to a level of 125% of Morrison's maximum total digestible nutrient requirement was found to help sustain these increases. Without the feeding of the extra nutrients the increases in fat test and milk production were only transient. With the feeding of extra nutrients the increase in fat test was noticeable for only a period of about 2 months. Over an entire lactation, the feeding of extra nutrients alone was as effective in increasing milk production as thyroprotein feeding with extra nutrients. Cows fed thyroprotein through several lactations produced less milk (mature-equivalent FCM basis) during the second and later lactations than during the first lactation, and the fat test was lower.

Body weight decreased in the cows fed thyroprotein more than it did in the cows not fed thyroprotein, at equivalent levels of TDN intake. A very rapid increase in body weight occurred immediately after the withdrawal of thyroprotein.

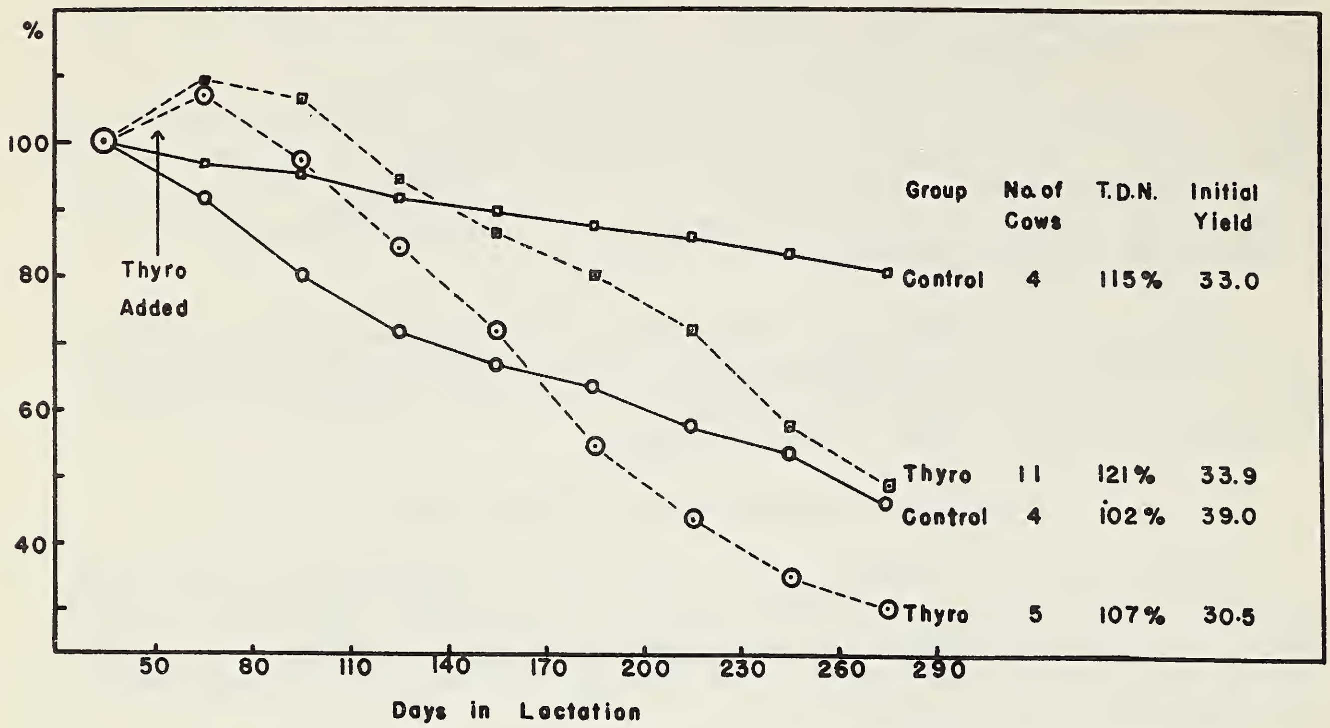

Figure 5.-Showing the effect of feeding thyroprotein and extra TDN (singly and combined) beginning at 50 days postpartum, on the persistency of milk production during the first lactation.

If one disregards the difference in body weight changes, the efficiency of conversion of TDN into milk by the cows fed thyroprotein was practically the same as normal cows for the first lactation. The efficiency was less than the value for normal cows in later lactations. When the usual TDN allowance was made for body weight changes, the cows receiving thyroprotein were less efficient than normal cows during their first lactation. The efficiency of cows fed thyroprotein decreased in subsequent lactations but remained constant in the normal cows.

The mortality rate of calves born to cows fed thyroprotein under the conditions of this experiment was higher than for other calves.

The evidence presented has demonstrated that it is not a desirable practice to feed thyroprotein to dairy cattle during the greater portion of the declining phase of lactations and especially so during successive lactations.

Stilbestrol in dairy rations

Present evidence indicates that the synthetic hormone product stilbestrol is effective in increasing the efficiency of rate of gain of steers. It has been suggested that stilbestrol might be effective in increasing milk production. In limited studies at Beltsville the feeding of 10 mg per day of stilbestrol for 60 days had no effect on milk production. In

digestibility studies with cows stilbestrol increased digestibility slightly but the differences were not statistically significant. At the present there is no good evidence that feeding stilbestrol in the amounts fed to beef cattle will increase milk production.

Future use of molasses

The use of molasses in dairy cattle rations will undoubtedly increase in the coming years. Its use in past years by the feed industry has been limited to a considerable extent because of sporadic variations in price and supply. These variations have been due largely to the use of molasses in the production of industrial alcohol. However, an increasing amount of alcohol is now being produced synthetically from petroleum products so that a larger and steadier supply of molasses will be available to the feed industry. The use of molasses for the various purposes is shown in figure 6. From figure 6 it can be seen that the utilization of molasses by livestock feeders and feed mixers has continued to rise as utilization by the alcohol industry has declined. In the 1945 fiscal year only 84 million gallons, or about 20% of the total molasses consumed, was used for livestock feeding purposes. In 1952 when total utilization amounted to 530 million gallons, 300 million gallons, or 57%, was used for feeding purposes.

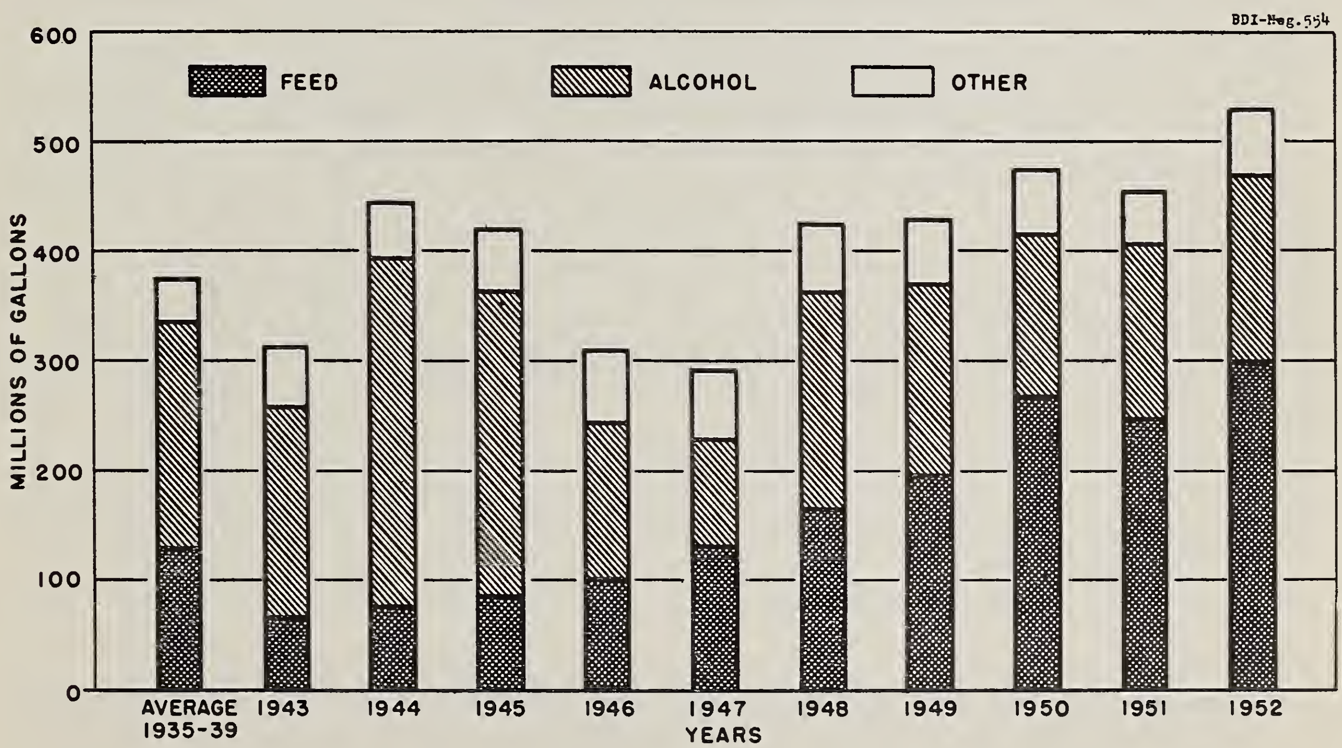

Figure 6.-Estimated utilization of industrial molasses in the United States by major use, 1935-52.

Blackstrap molasses from the cane sugar refining industry normally accounts for between 80 and 90% of the total supplies. Molasses from the citrus, beet sugar, and corn sugar industries make up the remaining supply. Molasses contains 50 to 60% of sugar and about 26% of water.

Feeding tests indicate that 6.5 gallons of molasses is equivalent in feed value to 1 bushel of corn. Thus, when the price of 6.5 gallons of molasses is below the price of 1 bushel of corn at point of utilization, it pays livestock feeders to substitute molasses in feeding rations. However, even under the most favorable price conditions, mixers rarely incorporate more than 25% of molasses in their feed.

During the 4-year period from 1947 to 1950 inclusive, the only sustained period of increased utilization of molasses for feed in the past 15 years, the price of molasses was from 8.6 to 16 cents per gallon or 30 to 50% below its corn-equivalent value. The variation in the price of molasses is shown in figure 7.

With greater stability in molasses prices in prospect, it seems entirely possible that the price of molasses could be stabilized at a price approximately 10% below the corn-equivalent feed value of molasses.

It may be advantageous in some areas to use molasses in bulk on the farm. If it is diluted and poured over unpalatable forages, the consumption of such forages can be increased.

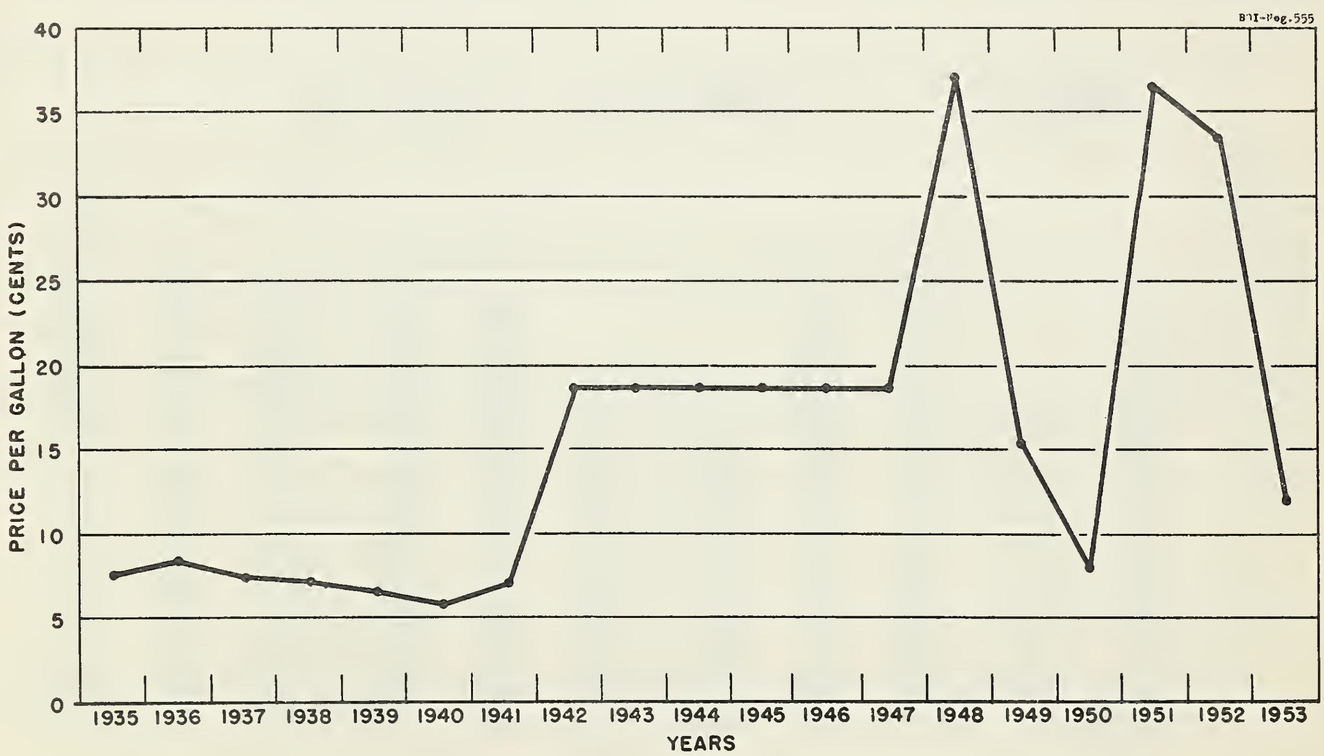

Figure 7.-Price of blackstrap molasses per gallon, by tank car F.O.B. New York, 1935-53.

Corn cobs and poor quality forages

In some areas there has been considerable interest in the utilization of corn cobs and poor quality forages especially for beef cattle. Insofar

as feeding dairy cattle is concerned there is nothing new or exciting in the utilization of poor quality forages. We have taught for years that where poor quality forages are fed more protein and energy must be fed in the form of concentrates in order to hold up milk production.

The cow's rumen, even though it is considered a large organ, has limitations on the quantity of dry matter which it will hold. If this space is filled with too much low quality, low energy feed, then milk production will suffer. In order to use poor quality forages the more expensive concentrates must be fed in order to keep up nutrient intake. If the quality is exceptionally poor then mineral and vitamin supplements are necessary. Thus the problem becomes one of economics. Can the farmer afford to purchase high priced supplements in order to hold a high level of milk production to utilize poor quality forages?

In experiments conducted at the University of Illinois on growing dairy heifers, there was no economic advantage to using cobs where the cost of the corn cob mixture which supplied liberal amounts of protein was $33.80 per ton with corn cobs at $6.00 per ton and hay priced at $25. to $30. per ton. Equal gains were obtained using the supplemented corn cob ration compared to the hay ration.

There are practical situations where it is necessary to use poor quality forages. However, we now have information which, if utilized, brings it within the power of each farmer to have good quality forage available for his herd. By making the first hay crop into silage in most areas good quality forage will become more generally available for feeding the dairy herds.

Inedible fats

The use of synthetic detergents, in place of soap, has made considerable quantities of inedible animal fats available for feeding purposes. Tallow has been added successfully to cattle, sheep and poultry rations.

In experiments conducted at the University of Connecticut and supported by funds from the Dairy Husbandry Research Branch, up to 10% of inedible stabalized tallow was mixed in calf starter rations. Four pounds of the calf starter was successfully fed per day. The added fat resulted in a 5 to 6% increase in rate of growth of the calves. Blood constituents were not altered.

In experiments conducted at the University of Illinois stabalized animal fat was added to the concentrate mixture fed to producing cows to the amount of 8.5%. The cows consumed the mixture readily and there was no marked effect on milk production or the constituents of the milk.

It would appear that inedible stabalized fats can be used in tomorrow's dairy rations but its use will probably depend upon price relationships between a high energy feed such as corn and the inedible fat.

Inedible fats could well be used if their cost were equal to or under 2 1/4 times the cost for grains. However, it is possible the feed mixer might wish to use some inedible fat to keep up the guaranteed fat levels of dairy concentrate mixtures and to reduce the dust hazard.

Rumen bacterial growth factors

Recent experimental results reported simultaneously from the laboratories of the Dairy Husbandry Research Branch at Beltsville and the Ohio Agricultural Experiment Station have shown that certain rumen bacteria require two types of short chain fatty acids for normal growth in the test tube. At our Beltsville laboratories it was found that Bacteroides Succinogenes, a cellulose digester, requires anyone of the branched-chain saturated acids, isobutyric, isovaleric or DL-a-methyl-n-butyric acid as one component. Anyone of a number of straight-chain saturated fatty acids C5 to C8 is required as the second component for the growth of these rumen bacteria under test tube conditions.

Whether the addition of materials containing these fatty acids to normal rations fed to cattle would cause an increase in the digestibility of cellulose is not known but it seems unlikely since these acids are present in the normal rumen fluid. Whether these acids are produced in sufficient quantity in the rumen to promote normal cellulose digestion, where an unbalanced ration is fed, such as one low in protein, is not known. However, until such time that good proof of the value of such products in the rations of cattle is forthcoming, we should guard against their indiscriminate sale and use.

Sprouting Grains

About 20 years ago an attempt was made to introduce the "Spangenberg process" of growing sprouted grains in cabinets as a source of nutrients for livestock. The grains, corn, barley, oats, etc., are sprouted in trays in a cabinet in contact with a hydroponic or nutrient solution. After 8 to 10 days of growth, the tray contains a mass of green material and roots. For instance, one pound of corn will produce four or five pounds of green feed material. A process is being offered for sale which is similar to, if not identical with the "Spangenberg process" has come to the attention of the Dairy Husbandry Research Branch during the past year.

The "Spangenberg process" was investigated quite extensively in Englang between 1925 and 1935. The results reported, where controlled experiments were conducted, were not advantageous for the process. Some investigators reported a loss of 25% of dry matter as a result of the sprouting process. This loss in dry matter would mean a corresponding loss in energy value of the feed. This respiration loss would be expected since the sprouts were not exposed to sunlight to permit the synthesis of energy bearing nutrients. Some analyses showed a gain in protein percentage but

it is not clear from the data whether there was an actual gain in protein due to synthesis or whether the gain was due to the dry matter loss.

Contrary to the claims for the "Spangenberg process" the feeding of sprouted grains did not result in an increase in the digestive processes of the animals. Also there was no improvement in the reproductive processes or general health of the animals.

In this present day trend of grassland farming where the principal source of nutrients for dairy cattle should come from forages, there would be little economic advantage to a process which would use grains in place of forage nutrients. If a farmer has poor quality forage there are present methods of supplementing the ration economically, for instance by the use of dehydrated alfalfa.

No data from the U.S.D.A. or Experiment Stations are now available to properly evaluate the new proposed process so that final judgment will have to be withheld. However, since the feeding of sprouted grains did not catch on in England or the United States twenty years ago it is unlikely that the process has very much value for the economical feeding of livestock.

Minerals in the ration

The addition of minerals to rations will probably not be altered greatly in the future. I assume that most commercially mixed feeds for dairy cattle contain added calcium, phosphorus, sodium and chlorine in the form of salt and probably some of the trace minerals such as iron, copper, manganese, iodine and cobalt.

There is considerable question in my mind whether the addition of calcium to grain rations of producing dairy cows in the form of calcium carbonate is of any special benefit. I cannot conceive that calcium deficiency would develop, because of the usually high calcium content of the forage portion of the ration. Where the commercially mixed feeds contain high protein concentrates, as is generally the case, it is very doubtful whether the addition of phosphorus is of any special benefit. The addition of iron, copper and cobalt is justified in many areas.

Effect of soft water on milk production

A couple of years ago information appeared in the literature, which indicated that cows receiving soft water produced considerably more milk than cows receiving hard water. We received many letters from interested parties asking for information about such reports. Experiments at the Virginia station have shown there is no difference between the effects of hard and soft water on milk production.

X - Disease

X - Disease or Hyperkeratosis first recognized in 1941 in New York state caused considerable losses of cattle in the years 1948-52. An

estimate of an annual loss of 2 to 4 million dollars has been made during the years the disease was most prevalent. The disease was characterized externally by thickening of the skin, profuse lacrimation, salivation, depression, anorexia, and loss of flesh.

Through excellent cooperation between the experiment stations and the U.S.D.A. the cause of the disease was traced to the use of chlorinated naphthalenes in lubricants. For instance, in one case the disease was traced to a lubricant used in the production of pellets. The incidence of the disease has decreased as a result of cooperation between oil companies and feed processors in eliminating chlorinated naphthalenes from lubricants which might contaminate feeds.

Milk fever

Parturient paresis, or milk fever, is a metabolic distrubance which occurs in cows shortly after freshing. It is characterized by a low blood calcium and a partial paralysis and is treated by intravenious injection of calcium salts or inflation of the udder.

Experimental work which has been in progress at the Ohio Station for about 10 years has shown that the occurrence of milk fever can be prevented by feeding 5 to 30 million units of vitamin D for 3 to 7 days pre partum and one day post partum. The level of blood calcium is maintained at normal levels by means of feeding vitamin D. The blood calcium raising effect of massive doses of vitamin D seems to be the result of a parathyroid replacement action for the maintenance of higher than normal blood calcium level during the critical post partum period despite the hypo-parathyroid function resulting from the vitamin D feeding. Irradiated yeast or viosterol were used in the experiment and were equally effective.

Published results from the California Station that a low-calcium high-phosphorus ration fed approximately one month before parturition will prevent milk fever. The investigators suggest that the prevention of milk fever results from a compensatory hypertrophy of the parathyroid gland due to the low-calcium diet, such that at parturition and the iniation of lactation, the increased calcium drain is compensated for by the increased mobilization of calcium from the skeletal reserves.

It thus appears that milk fever can be controlled by diet either by feeding a low-calcium high-phosphorus ration or the feeding of massive doses of vitamin D. It would appear from the practical standpoint that the feeding of massive doses of vitamin D for 3 to 7 days pre partum and one day post partum in herds where milk fever is a common experience would be a procedure worthy of recommendation. It is my understanding that several feed companies are now offering a milk fever prevention ration which consists of various vitamin D concentrates to be fed in amounts to provide no more than 30 million units per day for seven days or less.

Effect of rations on sterility and mastitis

While deficient rations can affect the reproduction cycle, there is no substantiated scientific evidence that practical rations as fed in this country have any effect on the ability of cows to conceive. Experiments from Denmark indicate that heifers that are reared on energy-deficient rations, so that the rate of growth is slowed, tend to remain in the herd longer as cows than do heifers that received high energy rations.

No scientific evidence is available at this time to indicate that feed has any effect on the development of mastitis.

Summary

In summary, it is evident that grassland farming will play a considerable part in the production of milk in the future. If protein concentrates become higher in price than carbohydrate concentrates, the protein content of mixed feeds will be reduced. Under such conditions the use of urea and such materials will probably increase. The use of thyroprotein for short periods under certain conditions may be economically feasible. The use of molasses as a source of carbohydrate will increase. The use of calcium carbonate in rations for milking cows should be discontinued.